SEA URCHINS AS A HIDING-PLACE FOR JUVENILE BENTHIC TELEOSTS (GOBIIDAE AND GOBIESOCIDAE) IN THE MEDITERRANEAN SEA

by

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ABSTRACT. - Associations between juveniles of two species of clingfish (*Apletodon incognitus* and *Lepadogaster candollei*) and gobies (*Gobius bucchichi*, *Millerigobius macrocephalus* and *Zebrus zebrus*) and two species of sea urchins (*Arbacia lixula* and *Paracentrotus lividus*) are described in the western Mediterranean Sea. The fish hide below the sea urchins between the spines.

RÉSUMÉ. - L'utilisation des oursins comme cachettes par des juvéniles de Gobiidae et de Gobiesocidae en Méditerranée.

L'association des juvéniles de deux espèces de Gobiesocidae (*Apletodon incognitus* et *Lepadogaster candollei*) et de trois espèces de Gobiidae (*Gobius bucchichi*, *Millerigobius macrocephalus* et *Zebrus zebrus*) avec deux espèces d'oursin (*Arbacia lixula* et *Paracentrotus lividus*) est décrite en Méditerranée (Côte nord de l'île d'Ibiza, Baléares). Les juvéniles se cachent sous les oursins, entre leurs épines.

Key-words. - Gobiesocidae, *Apletodon incognitus*, *Lepadogaster candollei*, Gobiidae, *Gobius bucchichi*, *Millerigobius macrocephalus*, *Zebrus zebrus*, Echinodermata, *Arbacia lixula*, *Paracentrotus lividus*, MED, Baleares, Hiding-place, Sea urchin.

Some years ago the association of the clingfish *Apletodon incognitus* (as *Diplecogaster bimaculata*) with sea urchins was described from the Azores in the Atlantic Sea (Patzner and Santos, 1992; Patzner *et al.*, 1993). Other associations of sea urchins and fishes are known in tropical seas (for review see Matthes, 1978; Zann, 1980). Fishes of different families are attracted to seek protection between the spines of sea urchins. The best known are several species of cardinalfishes (family Apogonidae) and the razorfish (family Centriscidae). Some partnerships are also described in clingfishes (family Gobiesocidae). Pfaff (1942) reports that the diadem clingfish, *Diademichthys deversor*, hides between the spines of *Diadema*. *Bryssetaeres pinniger* is usually found together with sea urchins in California. In New Zealand another clingfish, *Dellichthys morelandi*, is associated with *Evechinus chloroticus* (Dix, 1969). From the latter it is known that the sea urchin provides shelter and food for the fish. Analysis of the gut contents shows that the fish feed on the tube feet and pedicellaria of their host. In the Caribbean and the Bahamas *Gobiosoma multifasciatum* (Gobiidae) and *Labrisomus nigricinctus* (Clinidae) are reported to hide under sea urchins (Humann, 1994).

The aim of the present study was to get informations on associations of fishes and sea urchins in the Mediterranean Sea. Additional investigations are in progress.

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MATERIAL AND METHODS

On the northern coast of the Balearic Island Ibiza, near the village of Portinatx, sea urchins of the rocky littoral were investigated for associations with fishes. Down to a depth of one meter the work was done by snorkeling, in deeper regions by SCUBA. *Arbacia lixula* and *Paracentrotus lividus* are the most common sea urchins between the water line and a depth of 25 m. *Sphaerechinus granularis* occurs from 10 m down to this depth, but only in limited numbers. Therefore only random samples were taken for this species. All the observations were made during September 1994, 1995 and 1997. To get more informations on the most commonly associated species, *Apletodon incognitus*, 5 x 10 specimens of *A. lixula* and *P. lividus*, respectively, were checked at different depths (0 to 1 m, 2 to 3 m, 5 to 6 m, 10 to 11 m, 15 to 16 m and 20 to 21 m). The fishes were caught with the aid of Quinaldine (Fluka) which was diluted with alcohol at about 15:1. With a wash-bottle the liquid was sprayed around the sea urchins. After a short while the sea urchins were removed and the anaesthetized fish could be captured with a hand-net. The collected specimens were fixed in 5% formaldehyde and preserved in 70% ethanol. They are in the collection of the Naturhistorisches Museum in Vienna and in collections of the universities of Salzburg and Vienna, respectively. Measurements (standard and total length: SL/TL) were made to the nearest millimeter after fixation in 5% formaldehyde. The identities of the species were confirmed by H. Ahnelt (Vienna), R. Hofrichter (Salzburg), and P.J. Miller (Bristol).

RESULTS

Juveniles of 5 different species of fish were found to be associated with two species of sea urchins. Except of one species, *Gobius bucchichi*, the fishes were always completely hidden under the sea urchins and never observed leaving them spontaneously.

Apletodon incognitus Hofrichter and Patzner, 1997

This species was regularly noticed with sea urchins at all depths between 0.2 and 21 m. Figure 1 shows the associations with the sea urchins *Arbacia lixula* and *Paracentrotus lividus* at different ranges of depth. Normally one, but in 6% of the observations two and in 2% three individuals were found under one sea urchin. Co-occurrences with individuals of the other four fish species under one urchin were observed (see below). The largest *A. incognitus* found under a sea urchin measured 11/13 mm (SL/TL) in length. Additionally to *A. lixula* and *P. lividus* also some specimens of *Sphaerechinus granularis* were searched for associated fish. In around 15 m, 25% of the urchins were each settled by one *A. incognitus*. In one occasion 3 individuals were found together with one *S. granularis* at a depth of 10 m.

It was not possible to detect *A. incognitus* without removing the sea urchin. If the urchin was moved only a little, the fish stayed near the spines, attached to the rocky surface by its sucking disk. If the urchin was removed completely the fish stayed attached to the rock for some seconds. Then the fish swam ventral side downwards to reach another sea urchin in the neighbourhood. There it hid completely. The colouration of this species serves as camouflage and varies from green to reddish brown with irregularly arranged light spots.

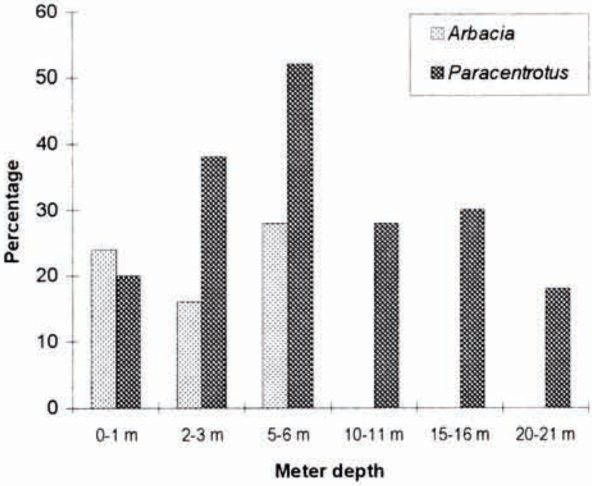

Fig. 1. - Association of *Apletodon incognitus* with the sea urchins *Arbacia lixula* and *Paracentrotus lividus* in different ranges of depth. No *A. lixula* were found at depths below 10 m.

***Lepadogaster candollei* Risso, 1810**

Around 4% of the sea urchins were associated with single juvenile or subadult *L. candollei*. Findings were made in water depths between 4 and 15 m. Mostly the fish were found under *P. lividus* and only rarely under *A. lixula*. In around 90% of the cases the sea urchin covered a small hole or crevice in which *L. candollei* hid. Only a few times these fish were associated with sea urchins sitting on a flat rocky surface. Mostly *A. incognitus* were found under the same sea urchin. The largest *L. candollei* found under a sea urchin measured 29/34 mm (SL/TL).

***Gobius bucchichi* Steindachner, 1870**

Of all the observed species juvenile *G. bucchichi* showed the weakest association to the sea urchins. In most cases the fish were seen in the vicinity of the urchins. Only when the diver approached did they flee between the spines and disappeared from view. *G. bucchichi* preferred groups of *P. lividus* rather than single ones or *A. lixula*. Findings were made in depth between 4 and 7 m. The largest *G. bucchichi* found under a sea urchin measured 23/28 mm (SL/TL) in length.

***Millerigobius macrocephalus* (Kolombatovic, 1891)**

In only three cases juvenile *M. macrocephalus* were found associated with the sea urchin *P. lividus* at depths between 4 and 10 m. Twice one specimen of *A. incognitus* was found with them. The largest individual under a sea urchin measured 14/18 mm (SL/TL).

***Zebrus zebrus* (Risso, 1826)**

From 0.5 to 10 m depth *Z. zebrus* was regularly found associated with both species of sea urchins. No preference to one of the species could be observed. Around 7% of the urchins were settled by this species. On no occasion was more than one *Z. zebrus* found under one urchin, although a co-occurrence with *A. incognitus* was common. The largest individual associated with a sea urchin was 21/26 mm (SL/TL) long.

DISCUSSION

Several fish species of different families have been observed in association with sea urchins (see introduction). In all cases, including the present observations, the fishes are protected by the spines of the sea urchins against predators.

In the Mediterranean Sea an association of fish and sea urchins was described recently for the first time (Hofrichter, 1995). An association of *Apletodon incognitus* (as *Diplecogaster bimaculata pectoralis*) has been published for the Azores in the Atlantic (Patzner and Santos, 1992; Patzner *et al.*, 1993) and Wirtz (1994) shows photographs of *A. incognitus* (as *D. bimaculata*) and *L. candollei* together with sea urchins in one of the Midatlantic islands.

Only for *A. incognitus* does the association with sea urchins seem to be more or less obligatory since the juveniles are very commonly found together with sea urchins in different parts of the Mediterranean Sea (Hofrichter, 1995), and only very few subadult specimens were caught in meadows of *Posidonia oceanica*. Juveniles of *L. candollei*, *Gobius bucchichi*, *Millerigobius macrocephalus* and *Zebrus zebrus* were also found in various other habitats (Pölzer, 1994; Hofrichter, 1995; Patzner, in press).

As far as is known, all the observed fish species associated with sea urchins have their reproductive season in the Mediterranean Sea during late spring and early summer (Miller, 1986; Pölzer, 1994; Hofrichter, 1995). From the measurements which were all obtained during September it can be concluded that only young of the year live together with sea urchins.

Gut contents of the New Zealand clingfish, *Dellichthys morelandi*, revealed that they feed more or less exclusively on tube feet and pedicillaria of their host, *Evechinus chloroticus* (Dix, 1969), and another clingfish associated with sea urchins, *Diademichthys deversor*, has also been found with tube feet in the gut (Pfaff, 1942). Random samples of four of the five species investigated (excluding *M. macrocephalus*) have not shown any echinoderm remains in the gut (Patzner, unpubl. data).

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Note added in proofs. - In July 1998 juveniles of a further species, *Tripterygion delaisi*, belonging to another family, Tripterygiidae, were found associated with sea urchins. They could regularly be observed with both species of sea urchins in depths between 4 and 7 m. It is obvious that this association occurs only around July because it never was detected during September, when the rest of the study was performed.

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